HDR Topic 2

Principal Supervisor: Dr Marta Krasowska

Title: Robust and Chemical Specific Sensors for Flotation Reagent Suites

Background

This project forms part of the Research Consortia Programme for *Unlocking Complex Resources Through Lean Processing*, funded by the South Australia Premier's Research and Industry Fund.

The research programme includes 12 industrial company collaborators and 16 academics from mining engineering, mineral processing, computer science, electrical and electronic engineering, mechanical engineering, and chemical engineering.

This is a unique opportunity for the successful applicant to work in this inter-disciplinary academic and industry environment together with other PhD students and post-doctoral researchers.

Project description

The successful applicant will work in the area of sensing of flotation reagents in mineral processing slurries. The specific project for this PhD position is to design, test, and implement novel polymer films (molecularly imprinted polymers – MIPs [1]) to be sensing substrates for gravimetric (using quartz crystal microbalance [2]) and spectroscopic (using FTIR spectroscopy [2]) techniques. These polymer films will be used to detect and determine the concentration of all reagents present in a flotation pulp mixture of particles, water, and chemicals. The method of detection will require physical chemistry skills and polymer chemistry skills to develop thin film coatings.

In particular, the objectives of the project are to:

(1) Synthesise and fabricate novel polymer surface coatings (MIPs) that will act as hosts for specific chemicals to be harvested from mineral pulps;

(2) Test the coatings for changes in film mass and spectroscopic response when exposed to specific flotation reagents;

(3) Calibrate the mass and spectroscopic response to allow determination of chemical concentration in the pulp;

(4) Work together with the industry partner (Magotteaux Pty Ltd) to produce proof-of-principle demonstration of sensor functionality at a mineral processing site.

Skills and background knowledge required of the PhD candidate

The successful applicant will have a good understanding of physical and polymer chemistry, in addition to sound knowledge of molecular spectroscopy and colloid/interface science.

Applicants should hold an Honours or Masters degree preferably in chemistry, chemical engineering, or another degree program that contains a significant amount of chemistry coursework. A Class 1 Honours degree or a Distinction or higher for a Masters degree with a significant research component, are highly desirable. Equivalent international qualifications will be considered.

Project milestones and deliverables

Note that this is a preliminary statement and, as with all PhD projects, the direction may change as ideas are developed and new data become available. The successful applicant, in consultation with his/her supervisors, will be required to produce his/her own research proposal which would include a detailed set of project milestones.

(1) Literature review and assessment of methods.
(2) Submit research proposal.
(3) Synthesis and coating of polymer films on QCM sensors and FTIR crystals.
(4) Testing of sensor platform in model aqueous solutions and mineral suspensions.
(5) Development of field-ready iteration of sensor platform.
(6) Testing of field-ready platform at mineral processing site.

Other milestones include formal annual reviews of progress under the UniSA HDR candidature procedures, the expectation that at least three papers will be written and submitted for publication in appropriate journals, and the writing and submission of a thesis.

References

[1] L. Chen, X. Wang, W. Lu, X. Wu and J. Li, Molecular imprinting: Perspectives and applications, Chemical Society Reviews, 45 (2016) 2137-2211.
[2] M. Krasowska, J. Zawala, B.H. Bradshaw-Hajek, J.K. Ferri and D.A. Beattie, Interfacial characterisation for flotation: 1. Solid-liquid interface, Current Opinion in Colloid & Interface Science, 37 (2018) 61-73.